ARCHAEOLOGICAL SITE AT LAKE MENINDEE, NEW SOUTH WALES

By NORMAN B. TINDALE, ANTHROPOLOGIST, SOUTH AUSTRALIAN MUSEUM

Plate XXV and text fig. 1-12

SUMMARY

THIS paper records the details of the finding, in 1939, of a site at Lake Menindee near the River Darling in Western New South Wales, where aboriginal relics and some human remains were present in a series of three superimposed old lake-shore deposits under circumstances implying the occurrence of at least three successive industries. These have been identified, in descending order, as representing the Mindukian, Pirrian and Tartangan culture horizons.

The mammals found at the site range from extinct species of *Sthenurus, Procoptodon, Protemnodon, Sarcophilus* and *Thylacinus,* etc., at the lowest level, to a present-day fauna, it being evident that the animals were in general relics of the hunting and feeding activities of the people who made their camps there.

INTRODUCTION

During the Harvard and Adelaide Universities Anthropological Expedition, 1938–1939, while travelling by car from Broken Hill to Menindee in Western New South Wales, on 23rd June, 1939, a chance roadside delay enabled some members of the expedition to spend an hour examining the marginal shore dunes of a dry lake where the highway from Broken Hill to Menindee, dropped down on to the dry floor of Lake Menindee, at a point 12 miles north-west of Menindee township. Mineralized bones, including those of several extinct species of mammals were noted, together with aboriginal implements, on a series of wind-blown erosion areas on the high bank fronting the northern shore of the lake. Actual first find was made by Mrs. D. M. Tindale. At the conclusion of anthropometric field work at Menindee Aboriginal Station Dr. J. B. Birdsell and the writer devoted several days to an examination of the site. A general survey was made, a partial contour map being prepared with improvized instruments, and numerous specimens were collected for study. These are now registered as A. 27628–A. 28148 in the South Australian Museum. It was the intention of the team to give additional attention to the site but the commencement of the War in 1939 prevented realization of plans. A brief preliminary reference to

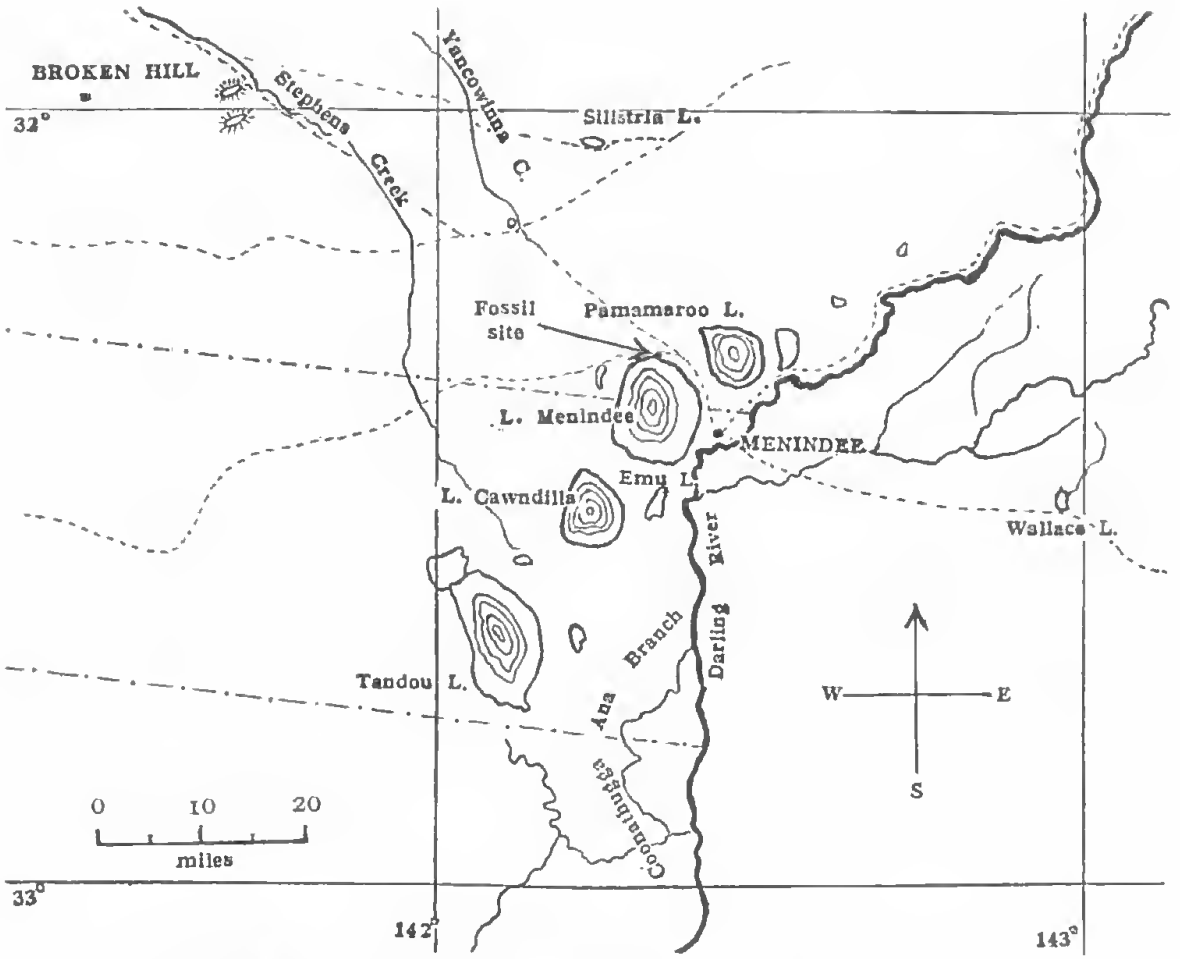


Fig. 1. Sketch map of the vicinity of Lake Menindee, Darling River, N.S.W.

the discovery was made by Dr. Hallam Movius in the Britannica Book of the Year 1940.

In March, 1953, the occasion of the visit to Adelaide of the mammalian palaeontologists, Prof. R. A. Stirton and Mr. R. H. Tedford, enabled the present writer briefly to revisit the area, and to introduce them to the array of fossil bones scattered over the area. It was then possible to check again the preliminary conclusions reached by J. B. Birdsell and the writer as a result of the 1939 work and to gather additional specimens. These also were included in the study and the following paper is a result. Prof. Stirton has given some general particulars and photographs in the journal, "Pacific Discovery", for March–April, 1954; the four illustrations on page 5 of that publication relate to the Lake Menindee site.

The identification of mammalian remains has been carried out by Mr. R. H. Tedford, who has kindly furnished a separate report on the mammal bones of Layer B.

Save some isolated human teeth gathered by Prof. Stirton from the surface of area B the human remains appear all to have been burials of bodies placed in holes in the ground in the flexed position. Thus they are transgressors in the beds to which they were introduced. Their positions furnish only limited evidence for their relationship with the other remains.

The implements and the fragmentary animal bones, being alike the waste products of camp life may tend to furnish somewhat more readily interpreted evidence as to the history of the site, and the animal bones, where they have been fragmented and burned in fire or fashioned into implements before they were buried will probably prove of the utmost significance as linking the aborigines with the mammal fauna, which they, by their continued living and hunting, doubtless helped to render extinct.

The main purpose therefore of this paper is to place on record the circumstances of the finding of the series of aboriginal remains and to discuss, in preliminary fashion, some of the cultural remains found in association with the series of animal bones. Other papers may deal in more detail with the mammalian and the human remains. A summary list of the principal human remains is given as Supplement A.

THE LAKE MENINDEE SITE

Lake Menindee is one of a series of flood basins and lake plains on the western side of the Darling River, which here flows southward as an entrenched meandering stream within a broad and mature valley many miles wide (Fig. 1). Its bed is largely cut into its own more ancient lacustrine deposits.

In 1939 Lake Menindee was, and within living memory, had been a dry plain, some miles across, with a rim of earthy sand dunes along an old lake shore. This shore was marked by a line of *Eucalyptus* trees, principally river-red-gum and box-trees.

However, in 1950 it became filled with water during the unprecedented rains of that year and in 1953 it still remained a full sheet of water in the shallow margins of which were growing many lignum bushes.

The principal fossil site is situated near the northern extremity of the Lake, just to the west of the old surveyed main road which runs from Broken Hill to Menindee. The place is near the point where the road descended from the higher plain to the floor of Lake Menindee plain. The site is about 12 miles north-west from the river township of Menindee.

Shore features of this old lake include sand dunes, some red and earthy, others of coarser and sharper sand forming a wall up to fifty feet or more in height and of a width varying from a few hundred yards to half a mile.

In 1939 the shore contours of the lake were rounded, and did not obtrude themselves, being masked by a canopy of blown sand. The advent of the water in 1950 re-established the freshness of the shoreline features and at the height of the flood nicked into and accentuated the steep sand-cliff which now fronts the area under examination. By 1953 the water was slowly subsiding, leaving the successive traces of its decline as "tide marks" along the lake shore.

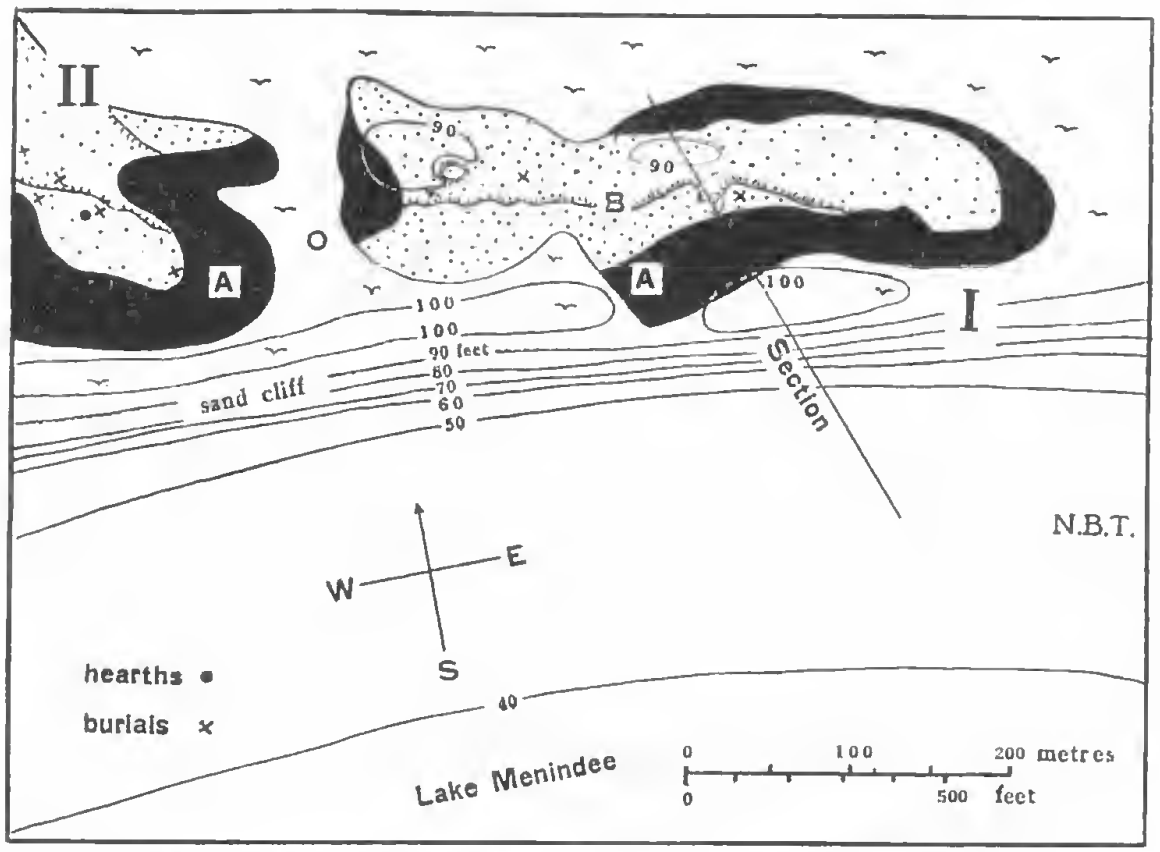


Fig. 2. Area I and part of Area II at Lake Menindee, as plotted in 1939.

During the 1939 visit to the site a survey had been made of the portions of the site that had become known to us as Area I and Area II (part only). A measured base line of 100 metres was used, together with some elementary surveying aids. A metric tape was available for linear measures but the heights were read in feet. The main features of this rough plan are reproduced as Fig. 2. The spot height of each of the major finds in the beds of Area I was noted, but as these do not furnish any particular information for this report they are not further referred to.

Contour heights were determined to a general accuracy of 0·5 foot using the highest point of the measured cross-section of the beds as an arbitrary 100-feet datum. On the basis of this datum point the "dry" lake floor near the

shore lay at forty feet or thereabouts, rising ten feet to a beach, and further as a shore cliff, some forty feet in height, to the summit of the measured section.

The shore cliff, after it became nicked at its base in 1950, was a steep very slightly indurated sand cliff, in places awkward to climb. The section, Fig. 3, shows the levels of the beds as worked out on the arbitrary scale of heights. In reproducing the plan, contours have been shown only at intervals of 10 feet although the original plotting was, in critical areas, recorded in more detail.

By 1953 shifting layers of superficial sand and further erosion had so far altered the appearance of the area that R. H. Tedford made new plans of Areas I and II on a somewhat less detailed scale and continued the mapping into Areas III and IV. The general and detailed appearance of these areas is shown in Fig. 4 which was reduced from a copy of his work plan.

THE SUCCESSION OF BEDS

Lowest and earliest bed exposed at this site is the one depicted as Layer B in the accompanying plans and section. The greatest thickness of it seen was about four feet (1·2 metres). The bed was not depthed during the course of this study. It is a buff-coloured sand containing calcareous pipes and concretions which on weathering produce a gravel of spheroidal calcareous nodules up

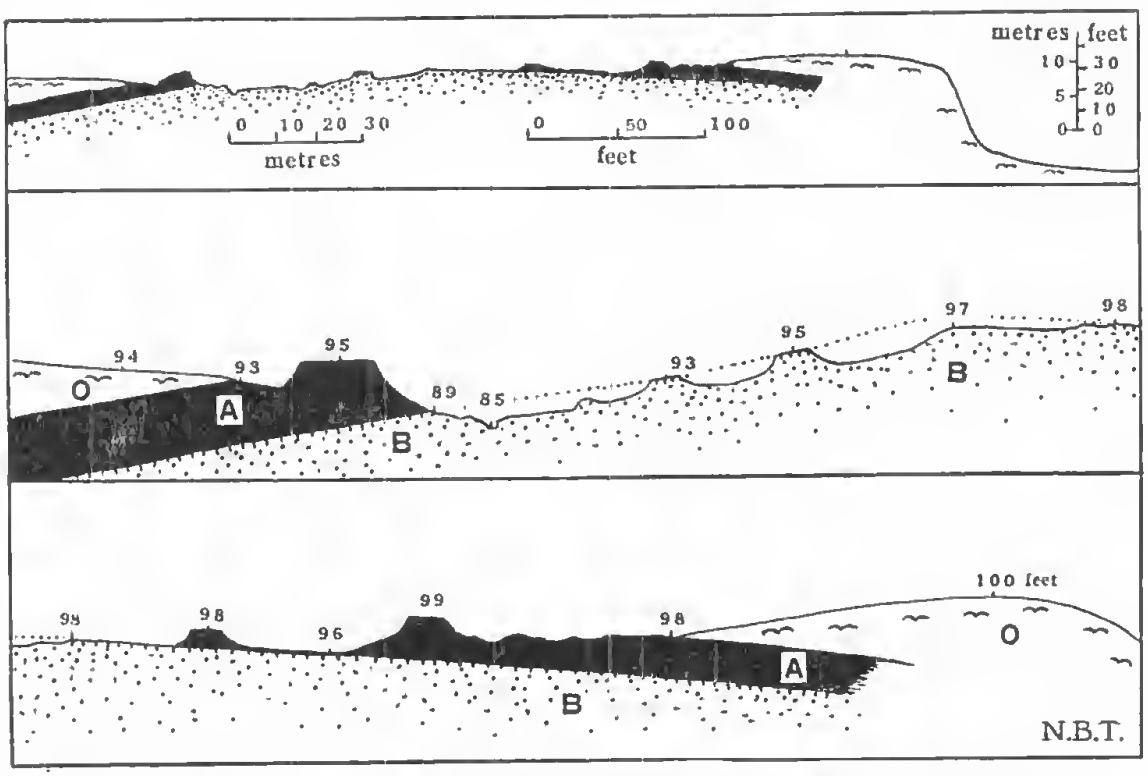


Fig. 3. Diagrammatic and detailed sections of the beds in Area I at Lake Menindee.

to 2 cm. in diameter, which everywhere characterizes Layer B exposures. The upper part of Bed B contains a slightly harder band which on weathering tends to stand up in miniature tableland formations, a foot or two above the rest of the bed and holding relatively sharp cliff edges. A minor erosional interval thus appears to have occurred between the laying down of Layer B and the appearance of a bright red silty sand bed (Layer A) lying above it. Proof of this appears to be that in more than one area the miniature erosional cliff feature of Layer B surface continues under bed A. In general the disconformity shown may be a minor one with only a moderate degree of erosion between Layers B and A.

Layer A as made known by erosional exposures varies from 2 to 4 feet (0·6–1·2 m.) in thickness. Its uppermost few centimetres tend to be grey and slightly indurated. It weathers differently from the slightly softer lowest levels of A.

In the preliminary field survey attempts were made to differentiate between an upper and a lower A layer horizon, but this yielded little additional information owing to the possibly subjective judgments necessary to prepare a good plot. On erosion Layer A does not shed any concretionary gravel residue.

The most recent bed is Layer O, lying unconformably on Layer A, and consisting of a wind-blown light red sand, coarse-grained in some areas, perhaps as a result of wind-sorting, partly held in control by dune vegetation, but merging into a drifting superficial zone denoted in the diagrams of this report by "flying bird" marks. The uppermost levels of this sand, where not fixed by vegetation, move about so relatively rapidly, under present-day conditions, that the amount of underlying beds exposed to view is subject to continual change. The different appearance thus created may be realized by trying to match the plan of Area I, as drawn in June 1939 (Fig. 2) with that done again, in somewhat less detail, by R. H. Tedford in April, 1953 (Fig. 4).

No significant differences have been detected in the beds as they reveal themselves successively in the four main areas of exposure. For the purposes of this report they are treated together although each of the specimens collected is so marked that its source can be reviewed, on an individual area basis, when this is deemed desirable.

In the gathering of the fossil and archaeological material a few general principles were borne in mind. On the one hand uneroded witnesses, or uneroded blocks of late beds, from their surfaces tend to yield only relics of late culture. The greater the degree of erosion and the larger the number of beds involved the greater the mixing with earlier culture strata.

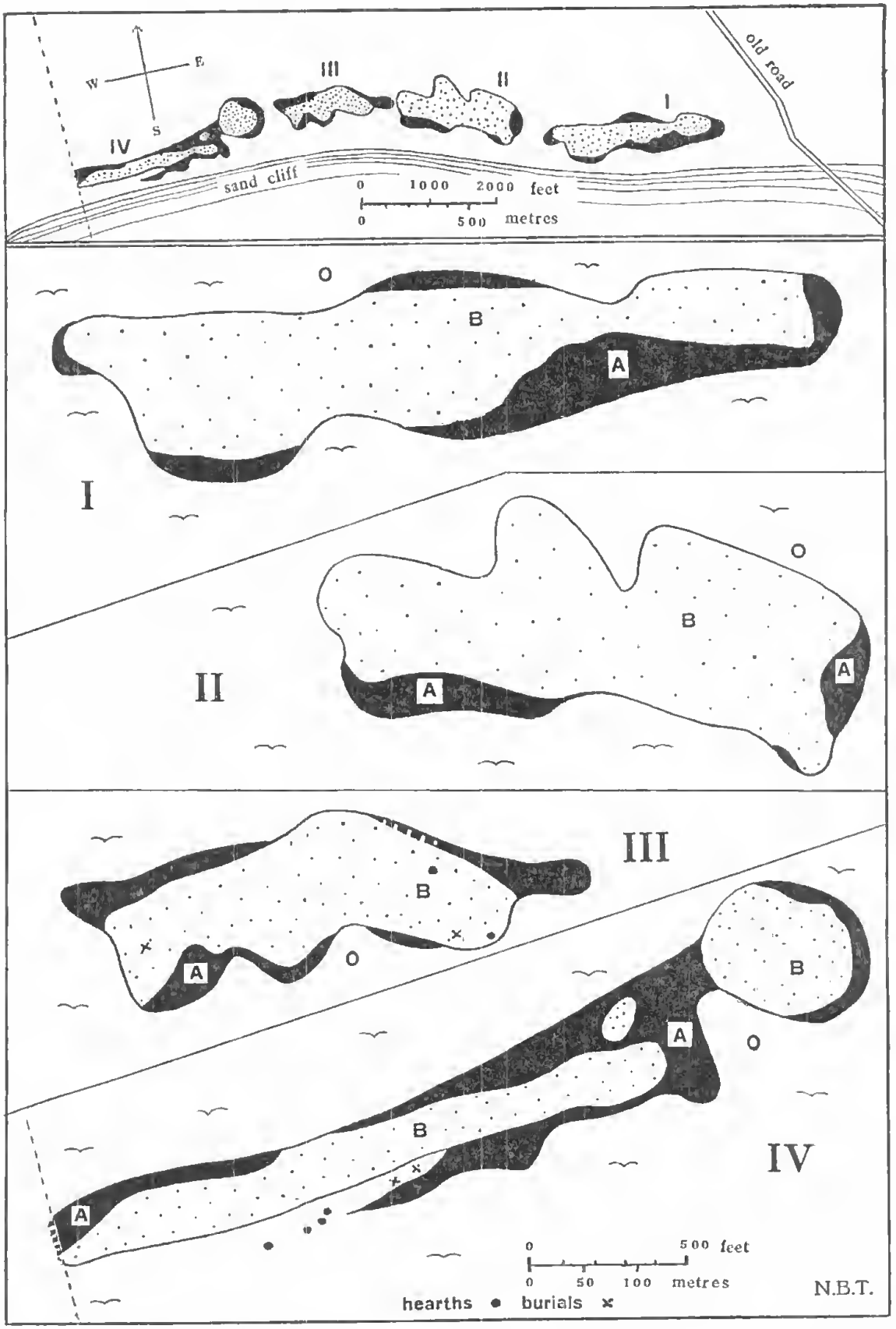


Fig. 4. Areas I–IV at Lake Menindee, as mapped by R. H. Tedford in 1953. (Positions of some hearths and burials added in Area III.)

On this criterion it was determined that microlith implement suites occurred as unmixed assemblages along with milling stones in and on the O beds and, where dropped on to A, they become mixed with *pirri* points, which joined them during the disintegration of bed A. The *pirri* implements themselves become more common as the base of A was exposed, while large semidiscoidal high-backed flake implements only became common on the top surface of B and in the erosion of B itself, where a few "horsehoof" implements also joined them.

The general impression gained thus was that the worked flake implements became larger and coarser as the beds became more eroded. This could not have been due primarily to any form of differential wind-sorting for many of the heaviest stones of all, the millstones, occurred on the uppermost deposits.

The distribution and succession of implements thus inferred led to the conclusion that, since Lake Menindee is not permanently supplied with water, a result of its periodical filling was a succession of camps made on the site, each registering a slightly different period of native culture. Since the margin of the Lake extends for many miles there may have been relatively long intervals between some successive camping episodes at a given place. The mammalian and shell remains found seem to be the food remains of these camps. They are scattered among the implements and on occasion are found broken and burned as if they have been subjected to the heat of cooking fires before being incorporated in the layers in which they had become imbedded. (Plate I h and i).

The intermittent character of the occupational deposits at the site seemed to be manifest in another way. The areas of distribution of individual camp sites tended to be less than the total area of the outcrop of the exposed beds. Camp sites in Beds O and A were not always directly above areas containing B horizon camps, so that partial separations of the implement-bearing strata were observed and the contents of the several strata could in part be isolated on such evidence. Thus it happened that in only a few places were crescent-shaped microlith implements of Layer O dropped on to the areas of B under study. In general the B camps were further away from the lake shore than sites favoured by later visitors to the site. This was possibly due to the growth lakeward of the dunes in course of time. In other places, e.g. in part of Area II, B itself was overlain by a sterile or relatively sterile bed A and from this area in particular only one *pirri* point and no crescents were recovered. The inference is that here the implements of an earlier period are present as a relatively "pure" association. Details such as this tended to support conclusions to be drawn from a more directly statistical treatment of the implements.

STONE IMPLEMENTS

The stone implements, chippings, mills and hearthstones found at Menindee Lake site are all humanly transported ones since there are no immediately available deposits of rock from which they might have been derived by natural means. Hence the few critical examples found *in situ* in the several beds seem sufficient to establish the existence of man in the area during the periods of formation of all three beds, O, A and B.

The data from buried specimens is hard to come by unless they are just beginning to be exposed, and excavations, unless on a very large scale are not likely to be very productive owing to the low degree of concentration of specimens. As illustrating this the approximately 360 specimens including bone points, studied in this paper were retrieved from a surface area estimated as some 286,000 square metres of eroding surface; in round figures this is no more than one implement on each 800 square metres of exposed surface within the area of study On such a basis the chances are unlikely of establishing implement successions by any small excavation.

The best evidence is that furnished by the limited number of specimens still remaining *in situ* in the deposits, with their substance in part revealed at the surface. A few such specimens were found and marked as in A, in B, etc. The great majority of "floating" specimens could only be recorded according to the nature of the surface on which they were recovered, as "on A," "on uneroded B," "on eroded B", "on O", etc.

On the assumption that the primary disturbing factor in this remote spot was the erosional one, which occurred only after the country was overstocked with our animals in the past half century or more, it is possible to study the distribution of the implements found on the various surfaces and to make some tentative deductions from their occurrence.

The areas of exposed surface of the beds where implements occurred were in square metres, approximately as follows:

	I	II	III	IV
O	—	—	—	est. 10,000
A	20,000	8,500	13,500	30,000
B	65,000	68,500	33,000	37,500

This is a grand total of 286,000 square metres. The implements were not generally distributed on O, somewhat more widely present on A and still more

generally distributed in areas of B. The yields can be divided on a percentage-basis as follows:

	% of implements found	% of total camp areas examined
On layer O	7	4 (based on the one camp in area IV)
On layer A	24	25
On layer B	67	71

These figures are not very satisfactory since large sterile areas of O are ignored in making the calculations. Only in Area IV was there a large camp site on Layer O.

The readily recognizable implements recovered fall into seventeen rather loosely defined categories which may serve the purpose of this analysis. Some typical examples are figured in this paper. They are ones which occurred in and on the several beds in the following proportions:

	Approximate percentages		
Implement types	On and in Bed O	On and in Bed A	On and in Bed B
Blades	6	5	7
Microlith crescents	30	4	6
Microlith discoidals	6	0	under 1
Bondi points	3	0	1
Throwing balls	3	1	1
Cores (microlith)	3	0	under 1
Millstones	18	0	3
Irregular adzes	9	3	10
Adzes, on random flakes	18	19	23
Adzes, prepared platform	0	22	11
Scrapers, core-like	3	22	17
Elouera implements	0	1	under 1
End scrapers	0	1	under 1
Points, *pirri*-form	0	18	12
Karta-like implements	0	5	4
Horsehoof cores	0	0	2
Large hand choppers	0	0	1

From this table it may be deduced that the main implement types from the three principal studied beds, O, A and B, are different. Thus, no *pirri* appear above horizon A; they are most common in and on Layer A. When the contents of A beds are "dropped" by erosion on to eroded surfaces of bed B and become

mixed with B specimens they become fewer in proportion, because of the addition of implements of different types eroded from Layer B. In the same way microliths predominate in and on eroding surfaces of bed O; when dropped on to and mixed with specimens from Layers A and B they become, percentage-wise, far less abundant. The implications of this table seem to be in line with deductions that can be made from the specimens, few in numbers, which were found *in situ* in the several beds.

The total number of stone implements on which this rough analysis was based is 344, of which Layer O contributed 33, Layer A 80, Layer B 231. The number of specimens from Layer O is meagre, but was from a well-defined campsite area in Area IV and the implements tabulated were the result of much searching on surfaces which nowhere had been eroded down to the level of Layer A.

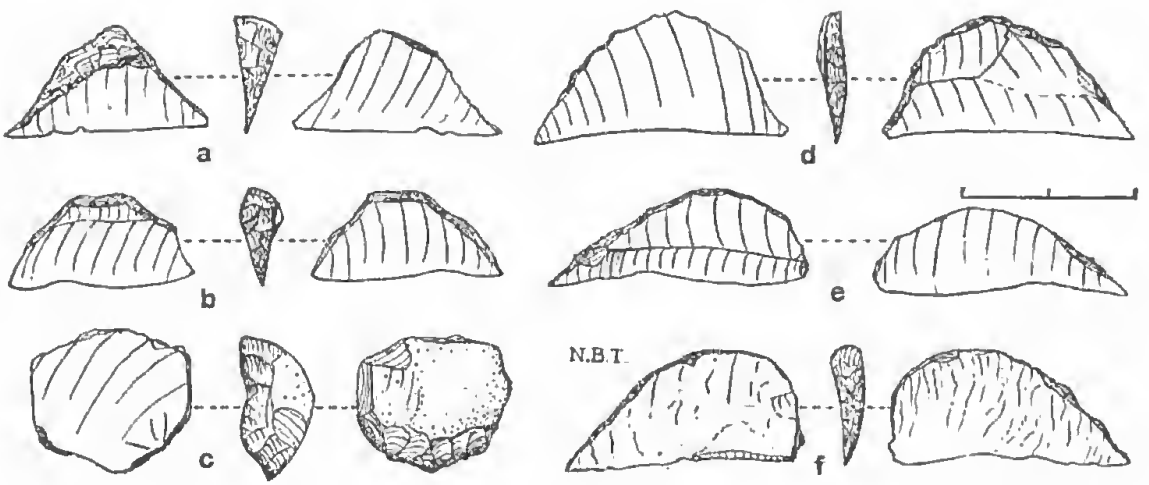


Fig. 5. Microliths from Area IV. a. triangle, b. crescent and c. discoidal adze on Layer O; d. crescent on B; e. *bondi* point on B; f. short *bondi* point, made from quartz crystal on uneroded B (natural size).

STONE IMPLEMENTS OF LAYER O

A few of the implements which appear to be characteristic of Layer O at Lake Menindee are shown in Fig. 5. They comprise crescentic and triangular microliths, some discoidal microliths and *bondi* points. Some are fashioned from a white, now slightly chalky, chert and others in fine grey quartzite, a greyish-white quartzite, and a greyish chert containing sandy nodules One *bondi* point (Fig. 5f) is very delicately worked in clear quartz crystal.

Along with these implements appear to belong adze stones made on casual flakes, such as shown in Fig. 6b.

At least a few of the "throwing stones" belong with this suite; an example is the one found on Layer O in Area IV and figured as Fig. 6a. It is made from a dull milky-white quartz. Other subspherical throwing stones were found lying on beds A and B, so that it cannot be established that such spherical

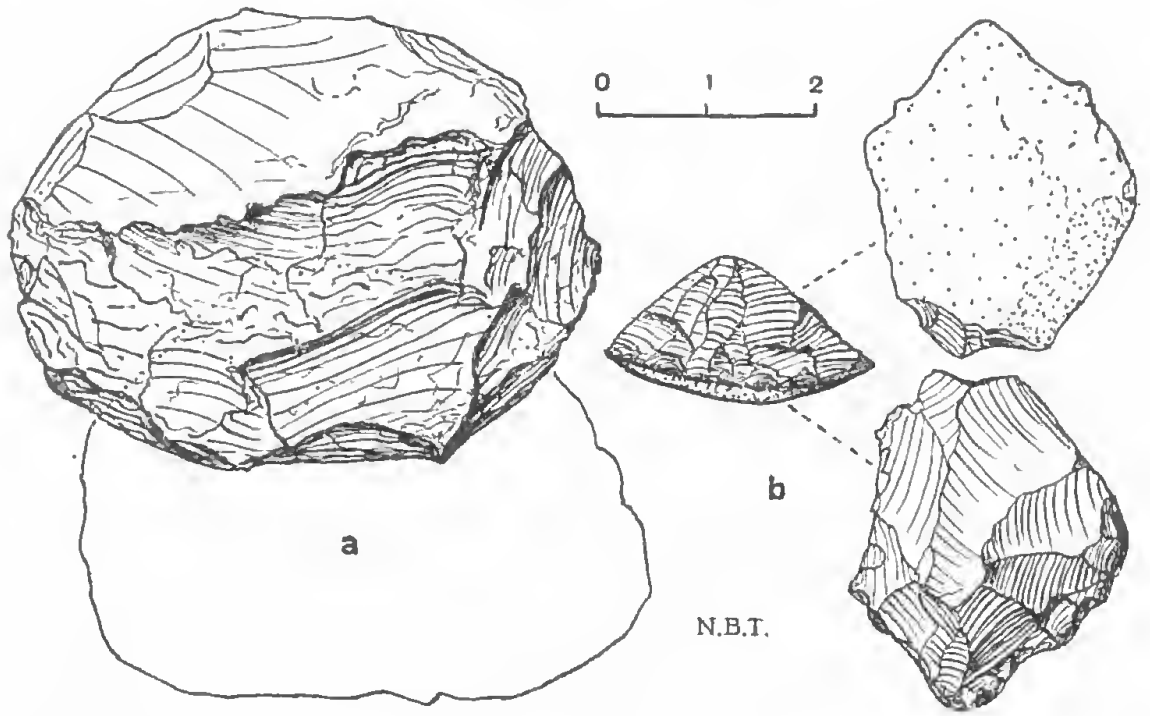


Fig. 6. Implements from Area IV. a. throwing stone of milky quartz, on Layer O; b. adze stone made from random flake, on Layer O (slightly under natural size).

trimmed stones are particularly an implement of upper horizons. However, they are known to have remained in use until modern times and an example of the implement as used by a living aboriginal of the Flinders Ranges, only some 200 miles to the west, is preserved in the South Australian Museum. Others occur in Kangaroo Island where they are associated with an industry (the Kartan) believed to be rather old.

Among known suites of implements those of this bed would best be placed with the Mudukian industry of Hale and Tindale (1930). It may be significant that the double-pointed bones, or *muduk*, characteristic of the industry at the type site, are absent. These are now known to be fishing toggles and their absence from this site could be accounted for by the absence of likely fishing sites on this shallow lake shore. The microlithic stone implement types recovered may be regarded as reliable indicators of the Mudukian industry.

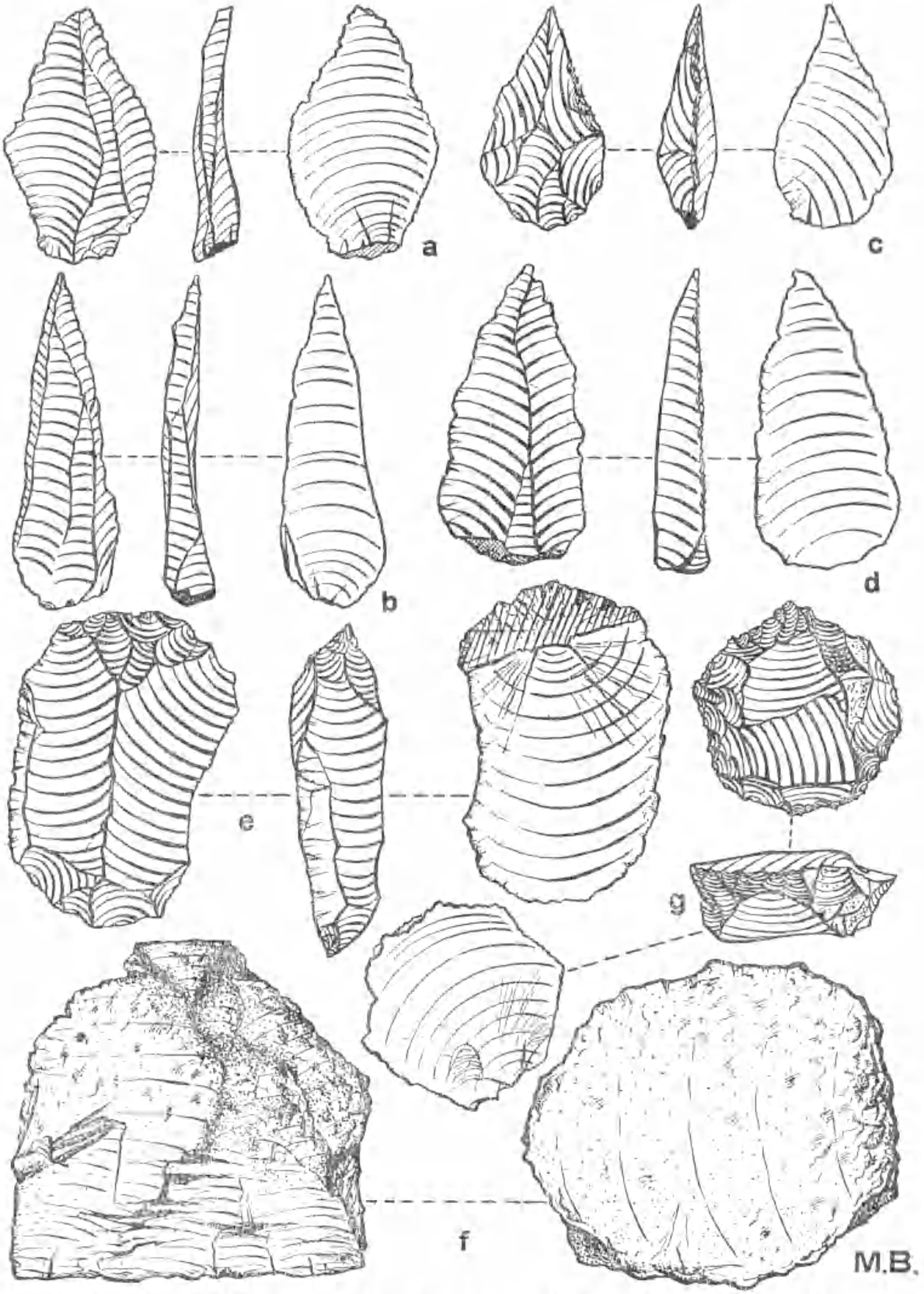


Fig. 7. Points and adze stones from Layers A and B. a. butted blade, in Layer A; b. butted blade, in Layer A; c. *pirri* point on lower part of A; d. *pirri* point on B, near a burial at Area III; e. endscraper, on A; f. high discoidal adze stone on A; g. discoidal adze stone made on random flake, found on B at Area II (all natural size).

STONE IMPLEMENTS OF LAYER A

In Fig. 7 are shown some implements which seem typical of Layer A. Projectile points of the types known as butted blades, and the developed form called *pirri* occur in and on Layer A but not in the layer above. On erosion of Layer A they are shed on to Layer B surfaces. Fig. 7a is of a specimen found *in situ* in Layer A and two others, Fig. 7b and 7c were on surfaces of A. Fig. 7d shows a specimen found on B beside the remains of a flexed burial which appeared to have been buried from a surface in A. It is not possible to establish that *pirri*-like implements do not also occur in Layer B, but on present evidence it seems reasonable to suggest that they are the most characteristic type of Layer A.

Coming also from this layer are a few end scrapers of which Fig. 7e is typical.

There are large numbers of high core-like discoidal scrapers of a type shown at Fig. 7f. This implement comprises nearly one-fourth (22%) of the artefacts of characteristic form recovered. The type is not characteristic of Layer O where the adzes are all on random flakes and much more squat in form.

Half the discoidal and other adze stones recovered on and in Layer A were ones made from flakes showing a prepared platform. These correspond to *tula* adzes and in their developed form are nearly equal to the best products of the famed Lake Eyre factory sites. Fig. 8a and d are excellent examples found on Layer A.

The balance of the adzes of Layer A are ones made on random flakes, Fig. 8b being a good example. The presence of the random flake adze is not diagnostic since it is found in all three layers appearing in increasing numbers from Layer O down to eroded Layer B.

The implement suite which emerges as characteristic of Layer A seems to be the Pirrian Industry, as defined by Hale and Tindale (1930). The projectile points are the same, as are also the very occasional *elouera*-like examples which occur. These are comparable with Fig. 195 in Hale and Tindale (1930).

There are some notable differences. At Devon Downs the few adze stones present were so worn by continued use in the manner recently described in detail by Cooper (1954), that little more than butts remained. At Lake Menindee, with sources of stone probably only a few miles removed, partly used adze stones are much more abundant and few show the great reduction which comes with long use and continued resharpening.

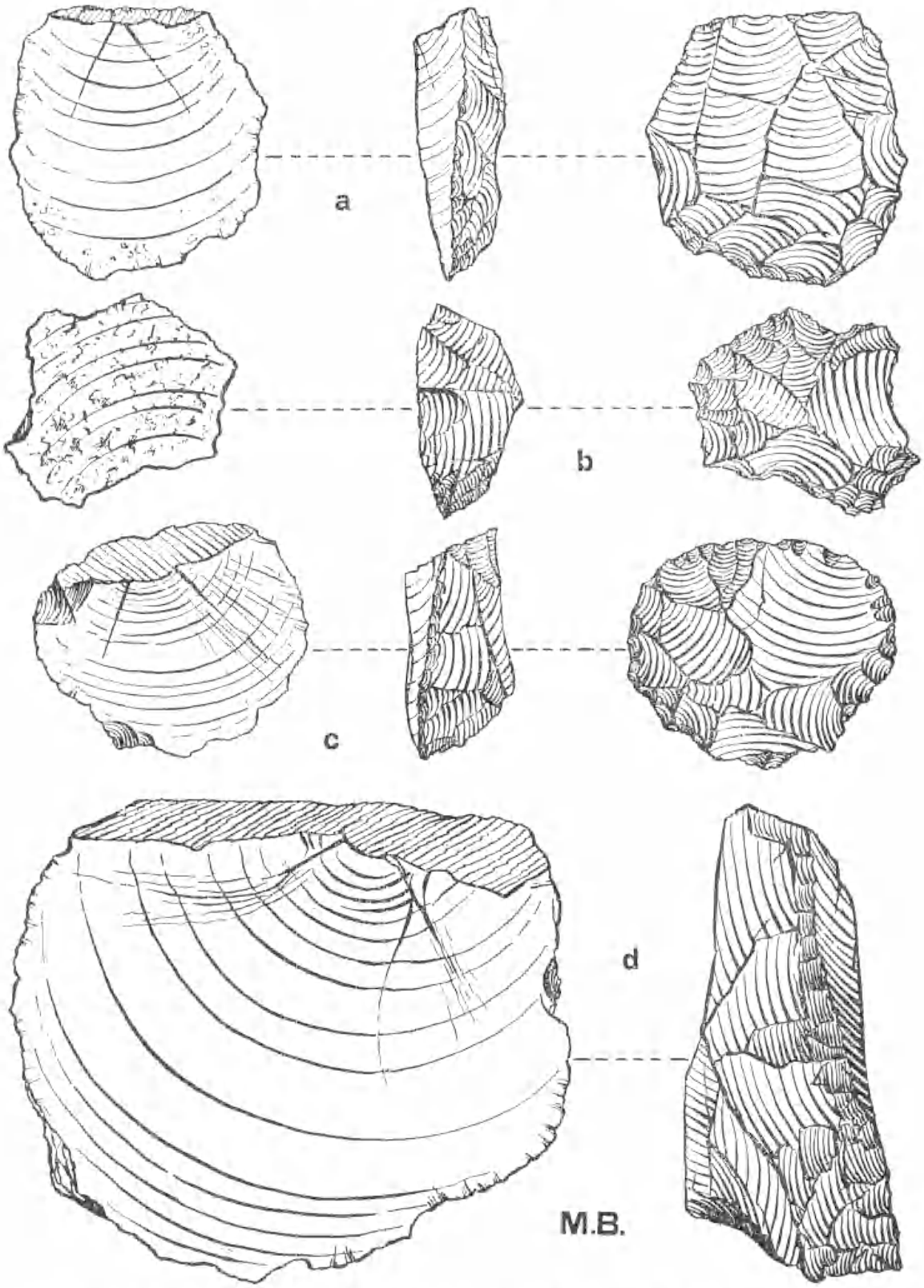


Fig. 8. Adze stones from Layers A and B. a. discoidal adze with prepared platform, found on A; b. irregular adze made from random flake, on A; c. discoidal adze with prepared platform, on B; d. large discoidal adze showing prepared platform, on A.

STONE IMPLEMENTS OF LAYER B

The only stone implements found *in situ* while excavating in B, were two flakes. One without secondary trimming was found by R. H. Tedford (his No. 38 from Area II). It has a dull white patina and is covered with the concretion of B. The other (A. 27729) was found during the 1939 visit in B at Area I. This is of a dull white patinated chert similar to several of the implements identified as of Tartangan facies.

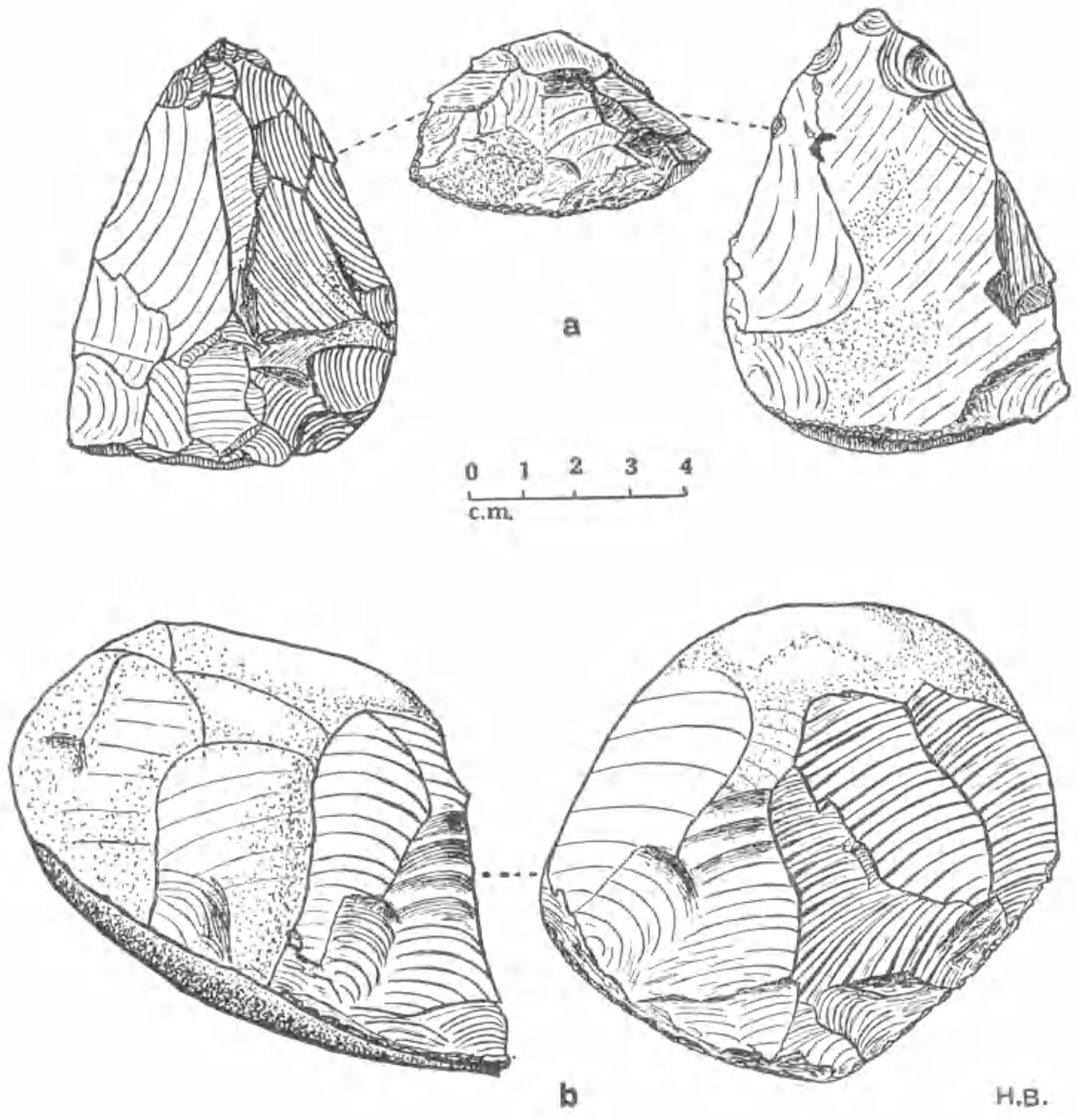


Fig. 9. a. small chopper on Layer B; b. large chopper *in situ* in a bed, identified as Layer B, two miles W. of Menindee township.

The total assembly of implements picked up on the eroded surfaces of B embraces at least some examples of each of the types characteristic of Layers O and A as well as those which might be contributions from within B, hence the assessment of what implements are from Layer B is not easy. Despite the relatively large numbers of implements retrieved from the surface of Layer B the majority of them must be ones dropped from Layers A and above; the implements belonging to Layer B are likely to be relatively few in numbers as compared with those from Layer A. However, it is not possible to clearly differentiate them, and it is only the appearance of kinds of implements not gathered from later beds which give any reliable indications.

Large "horsehoof" implements seem to be from this Layer, although one very battered one, which probably had been secondarily used as a source of flakes, was found on a B surface at a place where little or no erosion had taken place, hence presumably came from above the B horizon. Fig. 9a shows a large chert implement reminiscent of irregularly-shaped *karta* implements, and also of some of the larger implements found in the Tartangan beds by Hale and Tindale (1930). This is presumed to be a type from Layer B. Several like it were recovered from Layer B surfaces but none from the higher beds.

The finding of a rather fine hand chopper (Fig. 9b) at another site, two miles west of Menindee township, in a bed which is identified as probably equivalent to B (see notes on Other Sites, below) may tend to confirm the conclusion that large hand choppers, horsehoof implements, smaller core implements in great numbers and adze stones made on random flakes are all at home in Layer B.

These types in general are ones characteristic of sites of the Tartangan Industry, as first defined by Hale and Tindale (1930). Horsehoof implements themselves were not particularly associated with this industry at the type site but elsewhere they are quite characteristic of sites attributable to the Tartangan and earlier industries. Subject to confirmation it seems probable that men employing implements of the Tartangan Industry lived around Lake Menindee in the closing phases of the formation of Layer B and that at some time thereafter when Layer A began to be deposited they had been succeeded by people with a Pirrian Industry.

BONE IMPLEMENTS

Twenty bone implements, or pieces of them, were recovered at the site. Most of them were adrift on areas of A and B where wind erosion had exposed them; not one was found on Layer O.

Two series are evident; first those with stainings and adhesions which seem to indicate they were derived from bed A (Plate I e–g and Fig. 10 a–c) and

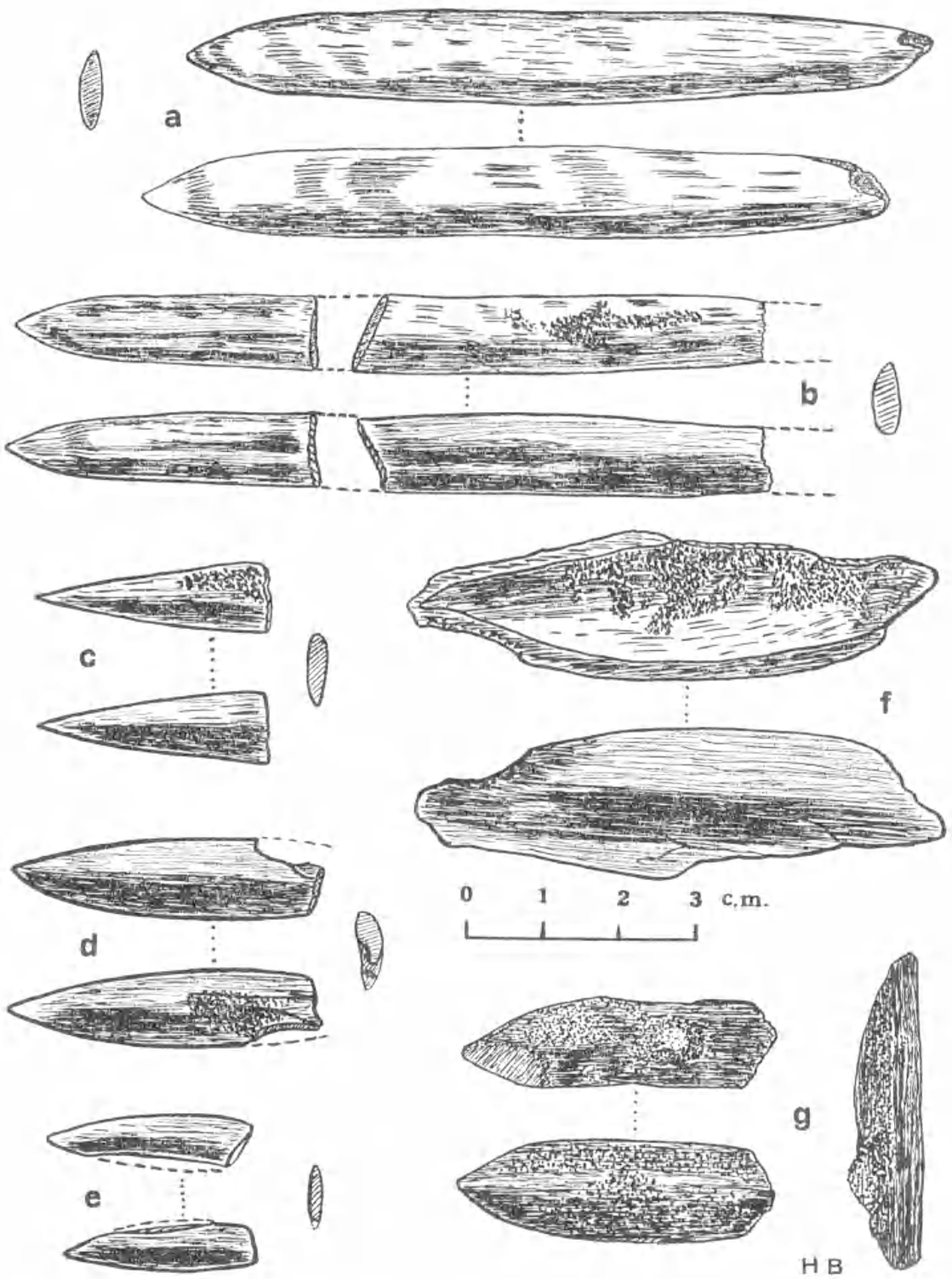


Fig. 10. Bone implements from Layers A and B. a. on B at Area III; b. on B at Area II (R.A.S. No. 4592); c. on B Area II (R.A.S. No. 4589); d. on B Area IV; e. on B Area II (part of R.A.S. No. 4589); f. on eroded B in Area I; g. in B at Area I (dotted portions represent matrix).

secondly, two examples which are from bed B. One of the latter has adhesions of B deposit (Plate I a and Fig. 10f); the other was found still *in situ* in B at a level judged to be 2 metres stratigraphically below the top of the bed. As figured (Plate I b and Fig. 10g) it still shows part of the matrix from which it was removed.

The bone implements considered to be derived from bed A are very characteristic and even the broken ones, which have snapped off, seem to have done so in a manner quite similar to ones found in Devon Downs Shelter Layers VIII-X, perhaps implying they were put to very similar uses. The two worked bones of Layer B are less easy to classify. Both are made from split pieces of massive bone and seem to have some relationship to ones found at Tartanga by Hale and Tindale (1930). It will be noted, however, that Fig. 10f bears some resemblance to the compressor-like piece of bone found in Layer IX (Pirrian Industry) at Devon Downs Shelter and figured by Hale and Tindale (1930, Fig. 224). The example found *in situ* is the pointed end of a length of massive split bone (0·5 cm. in thickness) which has been abraded to a point by rubbing in such a way as to leave two nearly flat oblique facets meeting at the outer cortex of the bone to form a point. Its general relationship might be with the bone implement from Tartangan beds figured by Hale and Tindale (1930 Fig. 24), but it is far more crudely finished.

FOOD REMAINS

The mammal remains at the site probably are in part the results of the bringing together of bodies of animals as food by the hunters who camped there. Not all are likely to be food remains since there are remains of animals which could have died there naturally. Others may have been the victims of predatory animals such as *Thylacinus* and *Sarcophilus* whose bones have been found at the site.

It is of interest to note that one of the extinct forms, *Sarcophilus*, was also found in association with Pirrian cultural remains, at Devon Downs Shelter.

No evidence of the dingo has turned up so far on the Lake Menindee site; it may have been an inhabitant of the camps of Mudukian or Pirrian times since a few limy coprolites, which could be of the dog were recovered loose on Layer B in 1939. Identifiable bone material was very scant from beds O and A. If the dog really was present perhaps the mammal bones were absent as a result of the omnivorous-eating habits of these animals which, on modern aboriginal camp-sites manage to dispose of most bone substance.

There are traces of fresh-water mussel shells *in situ* in hearths in all three of the principal beds. These shells seem to have been ones transported from the

lake as food. In general they have been subjected to fire, and hence all but a few are much disintegrated. Mr. B. C. Cotton has kindly identified the species as *Alathyria profuga*, Gould, 1851, a form which is still common in the Darling River.

Groups of shell fragments of large eggs occurred twice, both sets (A. 27920) and (A. 28103) on the surface of Layer B. Mr. Condon has studied these fragments and comments on them as follows:

A28103 consists of eleven irregular-shaped fragments, the largest 35 × 20 mm., the smallest 21 × 13 mm.; all except one have some of the matrix attached. The outer surface is smooth and unpitted, and some mineralization has occurred, but there is no trace of weathering. Thickness 1·0 mm. A27920 consists of 22 pieces, the largest 24 × 22 mm.; the other fragments are mostly smaller than those of A28103. The outer surface is smooth with some evidence of pitting. Some fragments have a dark stain, but all appear to be slightly less mineralized than A28103. Thickness 1·3 mm. A28043 is a single fragment 22 × 23 mm. and about 1·5 mm. thick. Both surfaces are covered with a limey incrustation.

In attempting to discover whether abrasion and weathering of a fresh egg of an Emu would result in a similar surface texture, an average-sized specimen, 138 × 91 mm. and 1 mm. in thickness, was rubbed with sandpaper until the coarse granulations were removed. It was found that the thickness of the shell was reduced to only 0·8–0·9 mm., and that the general texture of the shell showed little resemblance to the fragments under notice.

From comparisons made the fragments are shown to have no particular resemblance to any egg of a modern species. Curvature and thickness suggest an egg larger than that of the Emu (*Dromaius novae-hollandiae*) and it is possible that some species of fossil ratite (*Genyornis*, *Dromornis*, etc.) is involved.

ASSOCIATION BETWEEN EXTINCT FOSSIL MAMMALS AND ABORIGINES

The sole extinct mammal bone found *in situ* in Layer A which can be deduced as affording positive evidence of large extinct animals contemporary with people of Pirrian times is a lower jaw of *Procoptodon* with the two rami still joined together, found in a fragile state, *in situ* during the 1939 study. It is of course possible, since some erosion of bed B evidently had occurred before the deposition of bed A, that this was a disturbed fossil, brought up by accident on to Layer A, rather than an animal killed in Pirrian time. However, its presence appears significant. During the present author's second brief visit to the area part of an articulated leg which probably was that of a large bird, of the style

of *Genyornis*, was noted *in situ* in A; owing to an oversight this example was not collected by Professor Stirton's party.

The vast majority of the larger mammal bones are ones found on the surface, a few on A, usually where eroded down towards its base, but the bulk were lying on Bed B. Hence they might appear to have been contemporary principally with the relics of the implement industry here tentatively identified as Tartangan.

Burned bones were found in Bed B indicating man had subjected animal bones to fire. Plate I h shows an excellent example. The figure is of part of the right side of the rear part of a skull of the size of *Procoptodon* in the region of the orbit. This bone, its species not yet identified, was found by R. H. Tedford (his No. 62) as a loose specimen, or "float" on Layer B in Area III; it has matrix of Layer B still remaining attached, hence its horizon should not be in doubt. This matrix is posterior in time to the burning of the bone.

The presence of the bones and stone implements in apparent association in the one area could be fortuitous, and there are undoubted difficulties in the interpretation of all sites which have been exposed by wind erosion with consequent slumping of remains from one horizon to another, for despite every care in gathering the material, errors of interpretation undoubtedly can arise. Hence there is every reason to regard as tentative, the conclusion reached here, that the presence of so many animal bones together with native implements requires the particular explanation that at least some of the bones were brought together on surfaces of Layer B as food by early aboriginal hunters. The Layer B hunters seemingly left relatively few implements but many animal bones. The succeeding Pirrian people left abundant traces of occupation in the form of implements, but relatively fewer traces of the animals they hunted.

COLLECTIONS FROM OTHER SITES IN THE DISTRICT

During the 1939 visit heavy rains interrupted the field work. During interludes in the rain several sites nearer to Menindee township, on the Darling River, were examined. Beds which seemed to represent the three horizons, O, A and B were identified and further material collected. The results of these brief reconnaissances were given separate field marks in which Bed W=O, X=A and Y = B, these identifications being based on lithological similarities, which should be confirmed by further study. The principal sites were:

(a) 2 m. W. of Menindee township,
(b) 1½ m. S. of Menindee township,
(c) 1½ m. N.-W. of the Lake Menindee railroad cutting,
(d) 1⅝m. N.-W. of the Lake Menindee railroad cutting.

The "cutting" referred to is one where the railroad from Broken Hill, after skirting the shore of Lake Menindee, turns slightly to the east and cuts obliquely across the lake dunes towards Menindee township. The new (1953) highway, which avoids the Lake, instead of traversing its floor, crosses the railroad to the south side, just beyond the eastern end of this cutting.

The results of these reconnaissances yielded no data inconsistent with that from the main site. A few examples of the material therefore have been drawn to attention in the body of this paper and one specimen has been figured.

At the site $1\frac{5}{8}$ miles north-west of Lake Menindee Cutting on the windblown sand of the equivalent of the top surface of Layer O and extending slightly over on to a patch of uneroded A surface there is a Post-European campsite, possibly associated with the time of construction of the railroad. Here also were a few aboriginal hearths with some long blades, fresh wombat and rodent bones, fresh-water shells, pieces of red ochre, crude flakes and some remains of clay pipes such as were traded to and much used by aborigines in the period 1840–1880. There were neither microliths nor *pirri* implements on this site.

GENERAL DISCUSSION

The presence of several suites of implements on the Lake Menindee site which can be matched with ones from elsewhere encourages speculation as to their historical significance. In this the indications furnished by the excavations at Devon Downs and Tartanga some 300 miles downstream on the same river system are considered pertinent.

The microliths derived from Layer O are the same as those found in the Mudukian levels of Devon Downs Cave.

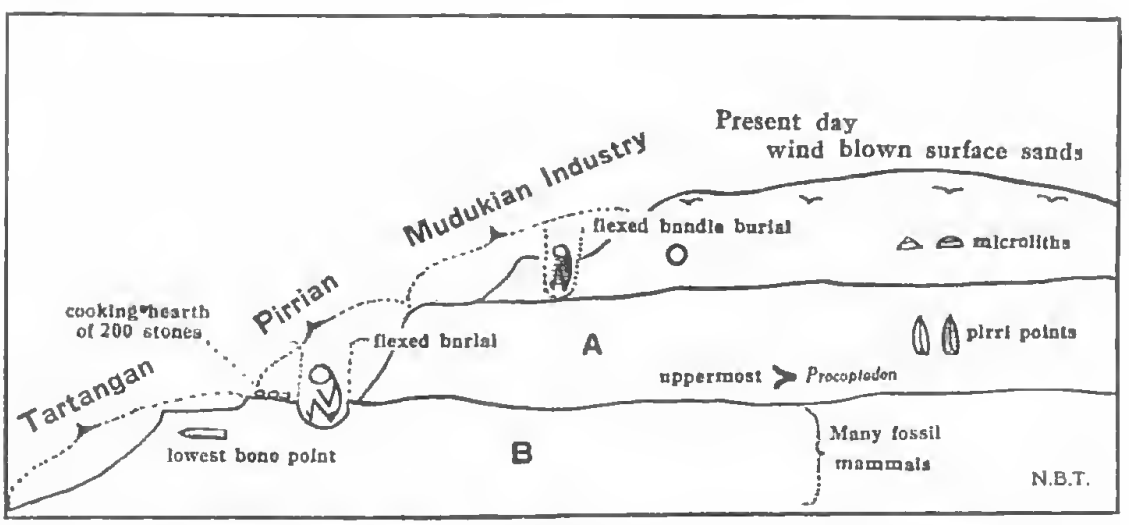


Fig. 11. Diagrammatic summary of relationships of principal finds at Lake Menindee.

The implements found in and on the eroded surfaces of A are comparable with the Pirrian Industry of Devon Downs. The suite of implements of Layer A dropped on to the uneroded surface of B may run as high as 25 per cent. in actual *pirri* implements, which would be regarded as a reasonable proportion on quite typical Pirrian sites. The relatively large implements of Layer B which appear where the bed is well exposed, seem to have affinities with those called Tartangan on the Murray River, although there are a few examples of *karta*-like implements which might be equated with the limited suites of implements of the Kartan (and allied Fulham Industry).

A generalized summary of the findings at Lake Menindee is given as Fig. 11.

The time interval involved between Layer B times and the present cannot at the moment be assessed with any great exactitude. It is hoped that some Carbon 14 determinations may soon become available for the corresponding sequences at Devon Downs and Tartanga. These may throw some light on the age of the Lake Menindee finds.

The only real clue so far available for Tartanga itself is based on the fact that the remains in the Tartangan beds became mineralized by immersion in water after they were deposited. This could have taken place during the Post-Glacial high-sea-level period, since the Tartanga site would then have been "drowned" and would have remained so through the period of high-sea levels. From this it has been deduced that Tartangan relics probably were deposited in the earlier half of the Recent Period with a terminal date indicated by Post-Glacial High Terrace time. On this basis the Pirrian culture which appears to have succeeded the Tartangan might have followed immediately after this mid-Recent episode. If this is substantiated by further work it may be possible to see the extinction of the older Australian mammal fauna as a gradual process brought about almost as much by the increasing toll of aboriginal hunters as by climatic vagaries in mid-Recent time. If the very tentative time interpretation worked out for Tartangan is applied to the Lake Menindee Site the continued presence of relics of aboriginal occupation in bed A certainly implies that any climatic changes involved during the formation of the bed were sufficiently moderate to permit of periodic returns by man to Lake Menindee, each time the lake became refilled with water, and the continued presence of man in the vicinity implies water was never very far away.

Looking further afield the evidence from Lake Menindee is in general harmony with data suggesting that the Mudukian and Pirrian Industries were widespread in parts of Australia, both along the coast and inland and that where both have occurred the Mudukian with its microliths was later in time than the Pirrian.

The particular phase of the Mudukian Industry which occurs in coastal New South Wales has been separated by McCarthy (1939, etc.) as a separate industry (the Bondaian) implying that it represented a separate coastal industry. However, typical Mudukian implements are "coastal" on the Coorong and at Penong in South Australia and the particular *bondi* points on which stress has been laid in distinguishing the coastal Bondaian Industry occur well into the interior of the continent, for examples at sites near Wiluna, at 62 miles north-west of Leonora, and at Smithsonia Waters, in Western Australia where they were found by Dr. J. B. Birdsell last year. These sites are unquestionably normal Mudukian ones. It is possible that the curious *bondi* points are really triangular needle points, used in piercing skins, when sewing them together for rugs and skin cloaks.

It is likely that in parts of eastern New South Wales as also in parts of South Western Australia and limited areas of Queensland the Mudukian (or Bondaian) was still the implement culture of the living aborigines at the time of white settlement; although it was undergoing replacement by the Murundian culture with axes, blades and crude adze flakes, it was still influenced by Mudu-

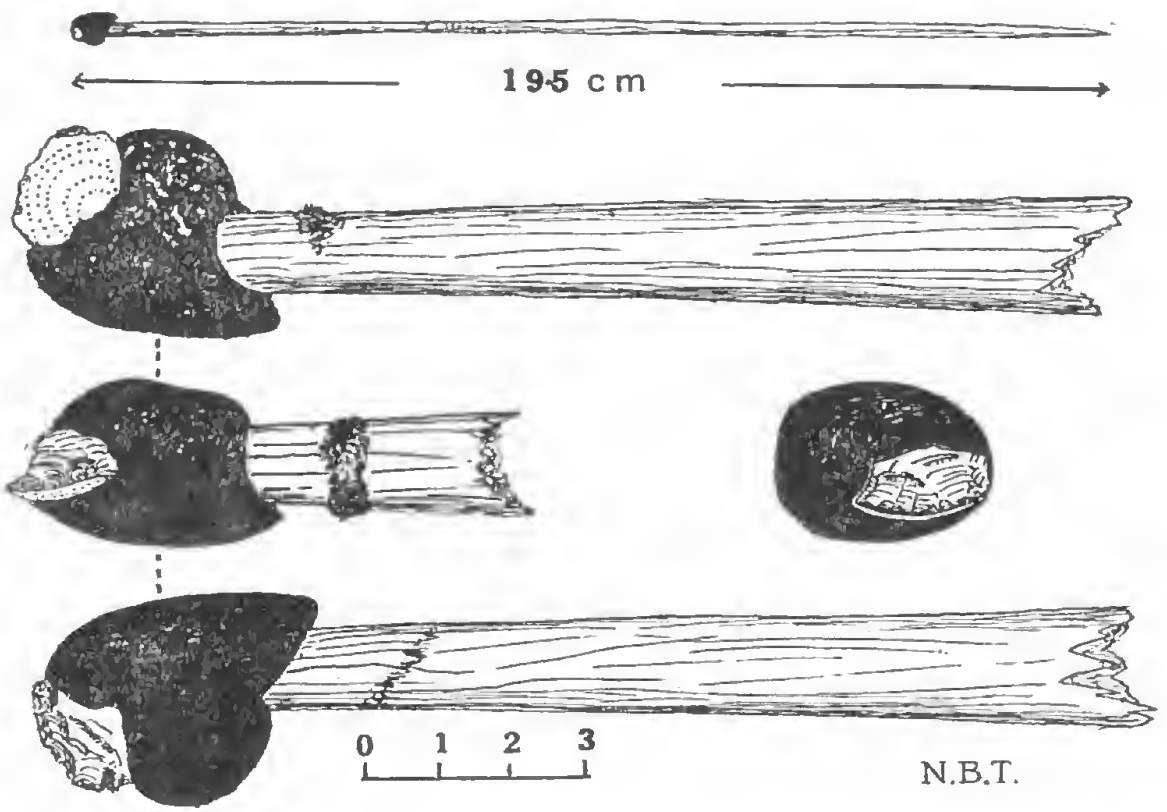


Fig. 12. Hafted microlithic discoidal adze, as used by the Maranganji natives of Beechall Creek, near Charleville, Queensland (example collected in 1886; A.31089 in S. Aust. Museum).

kian survivals. Apropos of this it seems of some little interest to note that microlithic discoidal adzes or chisels of the Mudukian culture phase survived, as functional implements, in the present-day culture of Western Queensland. There is an excellent example in our collection (Fig. 12) showing the mode of hafting employed. This adze and another were collected by Miss Dryer in 1886 from members of the Maranganji tribe at Beachall Creek (on the present Bierbank Station, 75 miles west south-west of Charleville). The second example, from the same place, lacks the stone but retains the impression of the butt of the microlith in the gum of the haft. Tests have shown that the long, slender handle (19·5 centimetres) provided exceptional control and balance for the adze, which seemingly could serve equally well as a chisel and graver in making the shallow grooves on implements, dishes and shields characteristic of the area.

The Pirrian Industry has not yet been found to occur in the coastal areas of Eastern Australia. The south-east-most localities as at present established are on the Coorong and near Mt. Gambier in South Australia and the most easterly in New South Wales is near Goondiwindi on the upper reaches of the Darling River. The westward and northern distribution of the Industry is now well established, since they have been turned up in Arnhem Land by Macintosh (1951) while Father Wurms recently has reported *pirri*-like implements from Dampier Peninsula, north of Broome. I have examined some of his specimens.

True *pirri* have been found by J. B. Birdsell and myself in the past year as occurring archaeologically over large areas in North Western Australia and the implements survived as a functional type of spear point until modern times in the Pilbara area of Western Australia, particularly among some people in the vicinity of the Hamersley Ranges. There are several hafted examples in this and other Museums which will be more fully described and discussed in a separate paper. It becomes possible to conceive that the surviving implement culture in some parts of Western Australia to-day is Pirrian and that further north the projectile point element of the industry evolved into the pressure-flaked spear point of the Worora, Ungarinjin, Djaru, Kitja and Wandjira tribe-people of North Western Australia. We have an archaeological sequence at Moola Bulla, North Western Australia, which substantiates this.

Notably missing from among the implements recovered at Lake Menindee are forms of edge-ground stone axe. This lack may have been fortuitous, but a relatively large area was searched and the absence is perhaps significant. It seems to be in line with indications at Tartanga and Devon Downs, admittedly on the very periphery of distribution of axes, that Mudukian microlithic sites lack edge-ground axes, which appear only in the subsequent Murundian horizon, perhaps indicating a late arrival of the edge-ground axe in this part of Australia.

The supposed "throwing stones" found at Lake Menindee are similar to ones found elsewhere in Southern Australia, both as to dimensions and weights. In the living culture their function is a known one as indicated by the general name, "throwing stone" applied to them. Their distribution, etc., is to be the subject of a separate paper. A Wailpi tribe term for them is ['mara] which elsewhere is a root-word for "hand". Fig. 6a shows a subspherical example of such a *mara* in milky quartz, which weighs 137 grams. This weight is slightly less than the mean of those in our collection.

The filling of Lake Menindee occurred in 1950 after phenomenal rains in Queensland and Northern New South Wales. Mr. B. Mason, of the Commonwealth Meteorological Service has kindly supplied some notes on this unusual happening:

"The year 1949 was wet in Queensland and New South Wales. Every river in both States was in flood. By the end of the year all the catchment areas of the Darling River showed rain records 20 to 30 per cent. above average. The year 1950 was even wetter, and by the end of the year all districts had had from two to two-and-one-half times their normal rainfall.

"In 1950 Darling River floods reached Menindee in April and by the end of the month the mark was 9 inches above flood level. It continued so for 13 months. Peak of the flood level, at 9 feet 4 inches was at the end of October, 1950. The long continuous period of flooding was most unusual.

"Records show that rainfall conditions similar to those which filled Lake Menindee in 1950, forcing the deviation of the old road across its bed, occurred in 1879 and 1890. There is evidently a lip over which the waters spill into the lake only at the highest flood level. There were lesser floods in the Darling in 1903 and 1921. The only other indications of unusual rainfall which might have a bearing, is the legendary account, from the coast of northern New South Wales, of very heavy rains at the end of the 18th century."

ACKNOWLEDGMENTS

The field work of the Harvard and Adelaide Universities Anthropological Expedition of 1938–39 was made possible by grants from the South Australian Government, the Carnegie Corporation of New York, the University of Adelaide and the Board of the South Australian Museum.

The field work described in this paper was done in company with Dr. J. B. Birdsell. Although his name does not appear as co-author much of the spade work was shared with him and full acknowledgment is made of his contribution to the work. The implications of the finds were discussed with him and the

appearanee of this paper is in no small measure a tribute to his eneouragement. Nevertheless, any errors in it are to be attributed to the present author.

The seeond visit to Lake Menindee was made possible through Prof. R. A. Stirton, who devoted part of a grant-in-aid from the Associates in Tropical Biography, University of California, to the journey. He and Mr. R. H. Tedford obtained additional material as well as many mammal bones for study. Mr. R. H. Tedford supplied identifications of mammals.

Mr. B. Mason, of the Commonwealth Meteorologieal Service, provided data on the phenomenal rains which filled Lake Menindee in 1950. Mr. H. Condon kindly examined some remains of eggs, and the identification of the fresh water shells was made by Mr. B. C. Cotton. Miss M. Boyce and Mr. H. Burrows are responsible for some of the drawings illustrating this paper; warm appreeiation is expressed for their contributions.

REFERENCES CITED.

Cooper, H. M. (1954) : *Rec. S. Aust. Mus.*, Adelaide, xi, pp. 91–97.

Hale, H. M. and Tindale, N. B. (1930) : *Rec. S. Aust. Mus.*, Adelaide, iv, pp. 145–218.

MeCarthy, F. D. (1939) : *Aust. Journ. Sci.*, Sydney, I, pp. 39–40.

MeCarthy, F. D. (1951) : *Oceania*, Sydney, xxi, pp. 205–213.

MeCarthy, F. D. (1951) : *Journ. Polynesian Soc.*, Wellington, 63, pp. 243–261.

Maeintosh, N. W. G. (1951) : *Oceania*, Sydney, xxi, pp. 178–204.

Movius, H. L. (1940) : *Britannica Book of the Year*, 1940. Arehaeology—Eastern Hemisphere, pp. 56–57.

Stirton, R. A. (1954) : *Pacific Discovery*, Berkeley, vii, (2), pp. 3–13.

DESCRIPTION OF PLATE XXV.

a. Possible bone compressor on eroded B in Area I; with adhering matrix of B.

b. Bone point found in B on Area I with some matrix still retained on it.

c-d. Tips of pointed bones, found on B in Area II (R.A.S. No. 4589); show adhering particles of Layer A.

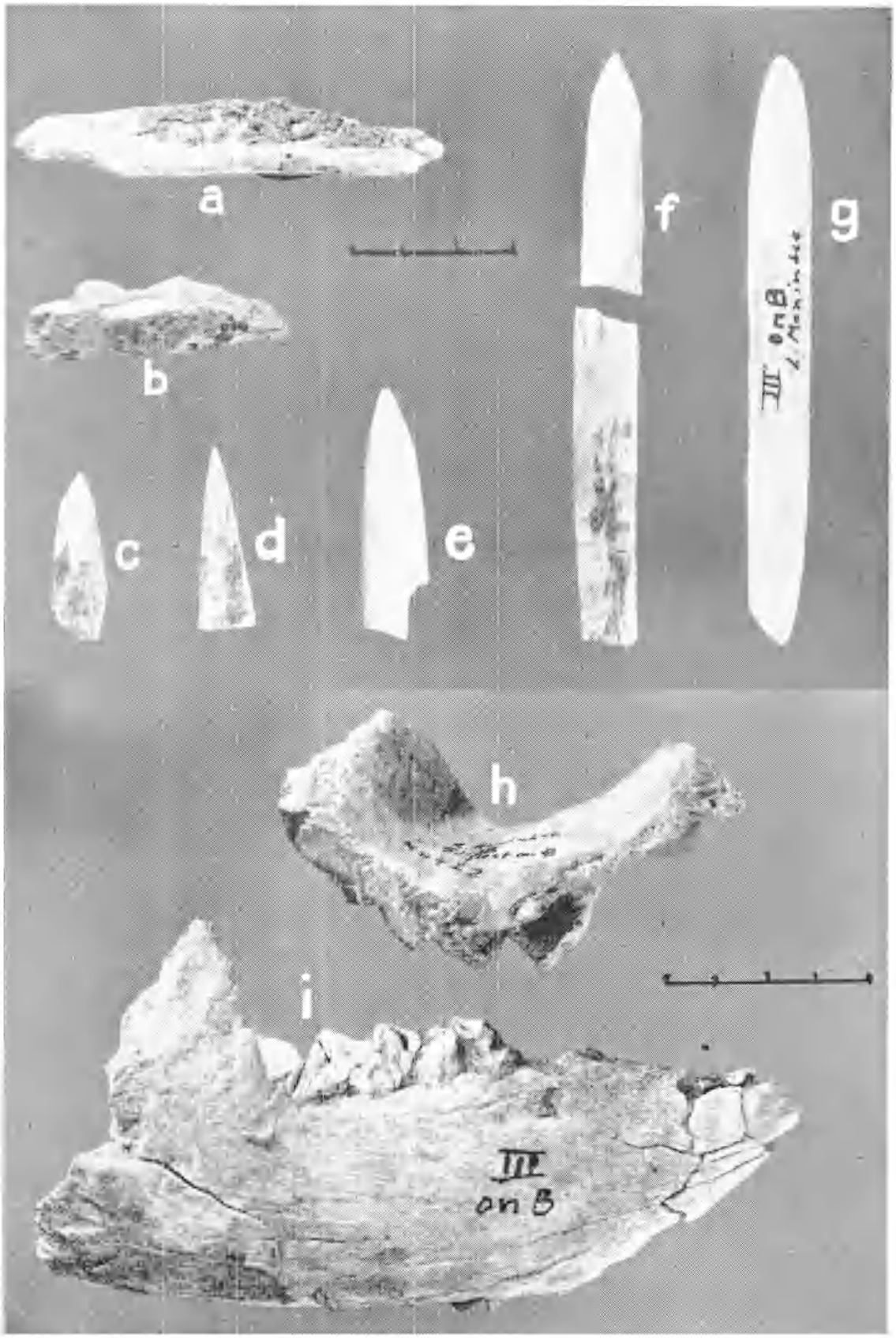
e. Tip of implement on B in Area IV.

f. Two parts of bone implement, on B in Area II (R.A.S. No. 4592); shows matrix of Layer A.

g. Complete bone implement on B in Area III.

h. Burnt bone with incrustation of Layer B found on B in Area IV (R.H.T. No. 62).

i. Typical jaw fragment showing probable traces of burning; on Layer B in Area III.



BONE REMAINS FROM MENINDEE.

SUPPLEMENT A.

THE HUMAN REMAINS.

The principal human remains found in 1939 are listed below. No attempt has been made to study them.

A.27712 was a partly mineralized human skeleton found at Area I in a circular pit dug through the lower part of A into Layer B, and situated immediately to the east of the measured section. The hole contained the soil of Layer A, indicating burial from a horizon in the upper part of A. The burial was in a flexed position, having been buried in the upright squatting position, pelvis to the north-east and knees to the south-west. Only the lower part of the trunk was *in situ*; the bones of the upper half of the body had partly disintegrated and were scattered over the adjacent eroded surface of B.

A.27759 comprised parts of an incomplete skeleton lying at the junction of A and B beds in Area II.

A.27763 consisted of bones of at least two persons lying on the surface of scarcely eroded B near to a hearth on the uneroded top surface of B. This hearth was *in situ* and fashioned from many transported stones. (A photograph suggests over 200 stones were present.)

A.27770 was the burial of a child lying on an eroded surface of B at the western end of Area III (approximately at the position shown with a cross in the 1953 survey of Area III). The remains were spread over an area of a diameter of 3 metres. It is estimated that 0·5 m. of bed B had been eroded from the area. The child may have been buried from a horizon in A but there is no evidence to contradict an even later interment from Layer O.

A.27725 consisted of fragmentary portions of the skeleton of a child found in Area I in an eroded area 1·3 metres below the level of the upper surface of B at a point 100 metres W. of the measured section. Some of the bones seem to have adhesions of the matrix of Layer B.

A.27734 consisted of scattered human bone fragments found on the surface of B in Area I, 155 metres W. of the measured section. The bones were mixed with various mammal bones scattered over an area of 3 metres diameter. The mammal bones showed more concretionary adhesions and appeared older than the human remains.

A.27752 was a burial the bones of which were scattered widely in Area II on top surface of barely eroded bed B, being evidently derived from A or above.

A.27752 was a burial near the eastern end of Area II, the bones of which had become scattered on the top surface of slightly eroded B. Seemingly it had been